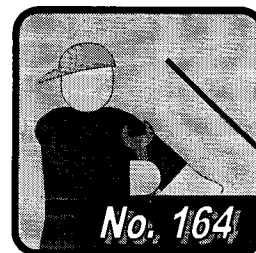


December 1999

MAINTENANCE BULLETIN

Alfa Company



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You are invited to send your ideas for, improving maintenance procedures, suggestions for articles, or comments on material published in the Maintenance Bulletin. Just write to the address below:

Officer in Charge, NAVFACENGCOMDET,

SEABEE LOGISTICS CENTER

1000 23RD Avenue
Building 1000
Port Hueneme, CA 93043-4410

SAFETY OF USE MESSAGE (SOU), TACOM-WRN CONTROL NO. 99-11,

"TECHNICAL" ESP AND FAMILY OF MEDIUM TACTICAL VEHICLES (FMTV)
CATERPILLAR 3116 ENGINE CONTROL ASSEMBLY RIVET QUALITY:
ESP: M35A3, LIN X40009, NSN 2320-01-383-2047;
M35A3, LIN X40146, NSN 2320-01-383-3850; M35A3C, LIN X40077, NSN
2320-01-383-2050; M35A3C, LIN X40214, NSN 2320-01-383-20490

TACOM-WARREN HAS RECEIVED A FLEET MANAGEMENT NEWSLETTER WHEREIN
CATERPILLAR INC. IS INITIATING A SAFETY PROGRAM FOR THE
INSPECTION/REPAIR OF 3116 ENGINES MANUFACTURED IN APRIL 1996 THROUGH
MARCH 1998.

A. A LINK TO THE GOVERNOR IS JOINED TO THE CONTROL ROD USING
A RIVET WHICH CAN LOOSEN, THEN WEAR AND EVENTUALLY FALL OUT RESULTING
IN LOSS OF ENGINE SPEED CONTROL.

B. EARLY SIGNS OF A POTENTIAL FAILURE ARE INDICATED BY LOW IDLE
INSTABILITY, ENGINE DYING FROM LOW IDLE OR ENGINE SURGE UNDER
OPERATIONAL LOADS. HOWEVER, THERE SHOULD BE NO SUDDEN CHANGES OF VEHICLE
SPEED OR LOSS OF VEHICLE CONTROL AS VEHICLE STEERING AND BRAKING WOULD
CONTINUE TO FUNCTION. SHOULD THE ABOVE WARNING SIGNS APPEAR, THE VEHICLE
IS TO BE SHUTDOWN/DEADLINED UNTIL INSPECTION/REPAIR CAN BE ACCOMPLISHED.

C. IN THE EVENT OF A WORST CASE SCENARIO (WHEREIN THE RIVET
TOTALLY SEPERATES FROM THE CONTROL ROD), ENGINE SPEED CONTROL WOULD BE
LOST WHILE ENGINE RPM SHOULD REMAIN VIRTUALLY CONSTANT, BASED ON LOAD.
DRIVERS ARE INSTRUCTED TO SHIFT INTO NEUTRAL, BRAKE/STEER OFF THE ROAD,
SHUTOFF THE MASTER POWER SWITCH AND APPLY PARKING BRAKE. IF THE VEHICLE
REMAINS RUNNING, MOVE AWAY FROM THE VEHICLE AND CONTACT UNIT
MAINTENANCE. ATTEMPTING TO STALL ENGINE AT HIGH RPM MAY RESULT IN INJURY
OR DEATH TO PERSONNEL.

UNITS WITH 3116 MECHANICALLY UNIT INJECTED DIESEL ENGINES WITH THE BELOW
LISTED SERIAL NUMBERS ARE REQUIRED TO IDENTIFY THOSE VEHICLES (WITHIN 7
DAYS) AND SCHEDULE INSPECTION BY AN AUTHORIZED CATERPILLAR DEALER IAW
THE FOLLOWING PROCEDURES:

A. ESP USERS NEED TO OPEN THE HOOD AND CHECK THE ENGINE DATA PLATE
ON THE VALVE COVER AT THE FRONT OF THE ENGINE FOR SERIAL NUMBERS IN THE
FOLLOWING RANGE:

S/N #5RM01263 THRU #5RM04201

B. FMTV USERS NEED TO RAISE THE CAB (PER TM 9-2320-365-10/PAGE
2-164 FOR LMTV AND TM 9-2320-366-10-1/PAGE 2-242 FOR MTV) AND CHECK
THE ENGINE DATA PLATE ON THE VALVE COVER AT THE FRONT OF THE ENGINE
FOR SERIAL NUMBERS IN THE FOLLOWING RANGES:

S/N #3RJ01653 THRU #3RJ02990

S/N #7AG02806 THRU #7AG05461

VEHICLES EQUIPPED WITH ENGINES WITHIN THE SPECIFIED SERIAL NUMBER
RANGE WHICH HAVE ACCUMULATED MORE THAN 10,000 MILES MUST BE INSPECTED
AND REPAIRED AS NECESSARY. UNITS ARE INSTRUCTED TO CONTACT THEIR LOCAL
CATERPILLAR DEALER TO SCHEDULE AN INSPECTION. INFORMATION WHICH MUST BE
PROVIDED TO THE CATERPILLAR DEALER INCLUDES: VEHICLE SERIAL NUMBER,
ENGINE SERIAL NUMBER AND VEHICLE MILEAGE. IF FURTHER/ADDITIONAL
INFORMATION IS NEEDED OR IF THE LOCAL DEALER IS NON-RESPONSIVE, THE
FOLLOWING CATERPILLAR REPRESENTATIVES MAY BE CONTACTED FOR ASSISTANCE:

LEN ANDERSON (309) 578-4562

OR

BOB WILLIAMS (309) 578-6143

Technical Service Information



Subject: Installation Procedure for New Unitized Pinion Seal Used in Spicer N Model Single Rear Axles and Rear-Rear Tandem Axles.

DESCRIPTION

NOTICE

The information supplied herein has been furnished by the manufacturer and/or the supplier for use with its product. Navistar International Transportation Corp. reprints this information based on representations made to the Company by the manufacturer and/or supplier and is not responsible for any errors or mishaps resulting from such errors or from any misuse of the product. Every user is urged to carefully follow the instructions which accompany the product.

PARTS INFORMATION

Table 1 Parts Information – Unitized Pinion Seal

Navistar Part Number	Spicer Part Number	
2503294C1	401HH105	New
	401HH102	Old
	GGAHH103	Old

Installation Instructions for Unitized Pinion Seal

Subject of Instruction Sheet:

Installation procedures for the new unitized pinion seal **P/N HH105** (Navistar **P/N 2503294C1**). Introduced Jan 4, 1999 in N model single rear axles and rear input of N400 tandem axles.

Purpose:

Provide the customer with installation instructions for the unitized seal that replaces the 401HH102 and GGAHH103 seals for service in the following models.

Affected Models:

Single Rear Axles:

J175-S	J190-SB	J210-S	J220-S	J230-SB
N175	N190	N210		

Tandem Rear Axles (Rear-Rear Pinion Seal):

J340-S	J380-S	J400-S	N340i
N400, N400i	S400-S		

PREPARATION:

1. Remove end yoke.
2. Remove pinion oil seal.
3. Remove any foreign material from the bearing cage or bearing retainer surface, then thoroughly clean the mating surface that will be in contact with the seal.

CAUTION: This is a "Unitized Seal," Do Not attempt to separate the halves of the seal. It does not come apart.

4. Remove slinger from end yoke and clean yoke surface that will be in contact with Seal. Use Emery cloth to remove any build-up present in the area shown. (See Figure 1)

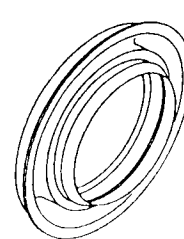
CAUTION: Seal cannot be installed with wooden block or soft hammer. Damage to the seal will occur. Use appropriate installation tools.

5. Using OTC seal installation tool (DST 1021) with handle (DST 1000-1), install unitized seal until fully seated into bearing retainer. (See Figure 2 for installation tool location on seal.)

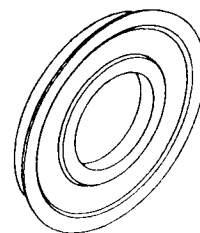
6. Install end yoke.

IMPORTANT: Do *not* remove yoke after being inserted through seal. Replace the seal if yoke must be removed.

7. If reinstalling old pinion nut, apply Loctite #680 to the threads and install pinion nut. Torque to 900-1200 Lb-Ft (1,220-1,627 N-m).
8. Check oil for contaminants and refill to proper oil level after seal has been installed.



Old Pinion Seal



Unitized Pinion Seal

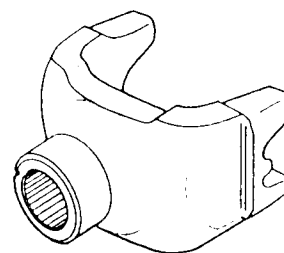


Figure 1

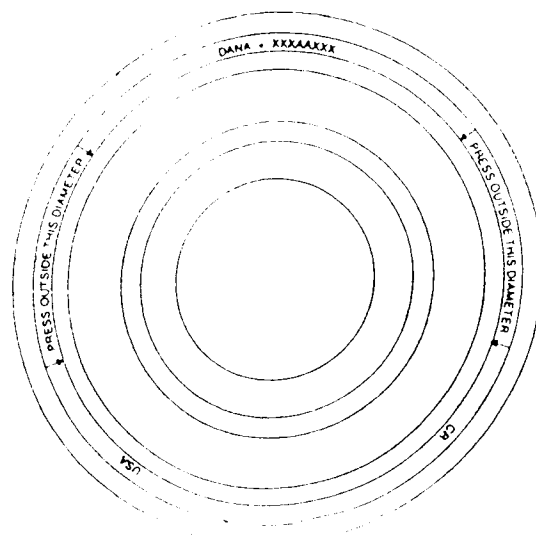


Figure 2

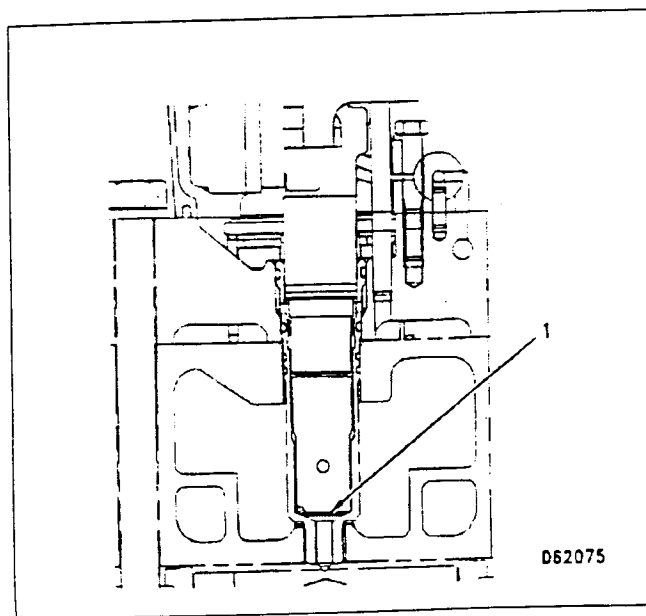
New O-Ring Seal Improves Engine Initial Combustion Gas Sealing (06-03-96)

1290

D9R (7TL, 8BL),
D10R (3KR) Tractors;
834B (7BR),
988F (2ZR),
990 (4FR) Wheel Loaders;
24H (7KK) Motor Graders;
PM-565 (3TK) Cold Planers;
631E (1AB1640-Up),
633E (2PS),
637E (1FB660-Up),
651E (4YR),
657E (5YR, 6PR, 6TR, 7KR) Wheel-Tractor
Scrapers;
769D (5TR),
771D (6JR),
773D (7ER),
775D (6KR) Off-Highway Trucks;
836 (7FR) Compactors;
5110 (7GN) Excavators

Description Of Change: A new O-ring seal is used in fuel injection pump groups in the above machines powered by 3408E and 3412E Engines with hydraulic electronic unit injectors, (HEUI). The new O-ring seal provides improved initial combustion gas sealing in the fuel injection pump groups in these machine engines.

Adaptable To: The new 9X-7681 O-Ring Seal is a direct replacement for the former 5P-9757 O-Ring Seal and is effective with 3408E (99C465-Up, 7PR1-Up) and 3412E (80M255-Up, 4CR500-Up) Engines. The new 9X-7681 O-Ring Seal is a component of the 108-7090 and 131-0468 Fuel Injection Pump Groups and adaptable to all earlier 3408E and 3412E Engines.



Typical view of the 9X-7681 O-Ring Seal (1).

Note: The new 9X-7681 O-Ring Seal may deteriorate as the engine hours build, but it will provide enough time for the unit injector to seal and seat in the adapter for the long term. Deterioration of the O-ring seals due to combustion temperature is normal.

Engine Oil Recommendation for 3408E (99C) And 3412E (80M) Engines (01-27-97)

1318

Caterpillar Machines Powered by 3408E and 3412E Engines

Caterpillar recommends the use of multigrade Caterpillar Diesel Engine Oil (DEO). Caterpillar oils are formulated to provide Caterpillar diesel engines maximum life and performance.

Multigrade Caterpillar DEO meets or exceeds the performance requirements of the American Petroleum Institute (API) CG-4 and CF-4 categories.

- CG-4 oils are designed to operate in the latest low emissions, direct injected (DI) engines and are especially effective in controlling soot and wear.
- CG-4 oils are the first API oils to place limits on viscosity loss.
- CG-4 and CF-4 oils are able to withstand high piston temperature to control piston deposits.
- CG-4 and CF-4 oils were tested with both low sulfur and standard diesel fuels.

Multigrade Caterpillar DEO is available at Caterpillar Dealers around the world. If multigrade Caterpillar DEO is not available, use ONLY the following commercial oils:

- Preferred Oils – API CG-4 is the preferred classification of commercial oil.
- Allowed Oils – API CF-4 is also allowed.

Engine efficiency and performance depend on the use of recommended lubricating oils and adherence to proper operation and maintenance recommendations. Failure to follow these recommendations may result in shortened engine life.

New O-Ring Seals Improve Sealing Properties of Flywheel Housing (08-18-97)

1164, 1157

988F (8YG), 990 (7HK) Wheel Loaders

Description Of Change: New O-ring seals improve the sealing properties of the flywheel housing on the above Caterpillar Machines.

Adaptable To: New O-ring seals have replaced former O-ring seals contained within the 4P-3581 Rear Gear Group and the 4P-3582 Rear Gear Group. When repairs are made to either of these rear gear groups, it is recommended that the new O-ring seals replace the former O-ring seals as listed in Chart 1 and Chart 2.

Chart 1: 4P-3581 Rear Gear Group	
New O-Ring Seal Part Number	Former O-Ring Seal Part Number
9X-7371	5F-3106
6V-8001	2H-6338
061-9456	7F-8268

4P-3582 Rear Gear Group	
New O-Ring Seal Part Number	Former O-Ring Seal Part Number
9X-7422	7J-6285
6V-8001	2H-6338
061-9456	7F-8268
6V-8260	5F-3999

Improved Support for Air Lines Groups (07-07-97)

1071

988F (8YG, 2ZR) Wheel Loaders

Description Of Change: An improved support is used on the above machines powered by 3408C and 3408E Engines. The improved support is stronger and has a better design.

Adaptable To: The improved 141-9648 Support is a direct replacement for the former 111-8878 Support Assembly. The 111-8878 Support Assembly has been discontinued. The 141-9648 Support is a component of the 123-0956 Air Lines Group, effective with the 988F (8YG1063-Up) 3408C Machine Engines. The 141-9648 Support is a component of the 125-0162 Air Lines Group, effective with 988F (2ZR719-Up) 3408E Machine Engines.

Troubleshooting Hard Starting

1250

Caterpillar Machines Powered by 3408E (99C) and 3412E (80M) Engines

There are several possible causes for 3408E and 3412E Engines that are difficult to start or will not start, or engines that will start but will not continue to run. Refer to the service manual for mechanical and electronic troubleshooting information and procedures.

Perform the following checks:

1. Visually check the fuel level and oil level. Verify minimum fuel and oil pressures.
2. Check for correct installation of the Electronic Control Module (ECM) connectors, speed/timing sensor connector, and the unit injector connectors. Verify that the ECM is receiving the correct voltage.
3. Check the injection actuation pressure control valve seals.
4. Use Electronic Technician (ET) to check for faults and logged events. While the engine is cranking, observe the engine speed to verify that the speed/timing sensor circuit is operating correctly. Verify that actual injection actuation pressure and current are normal.

Also refer to Power Connection Broadcast video and handouts for January 1999 (LEVN4568).

Since the 3408E and 3412E fuel injectors are actuated by oil pressure, the Injection Actuation Pressure System could be one possible cause. To begin troubleshooting a 3408E or 3412E Engine that is hard to start or starts and dies, compare the actual and desired injection actuation pressures while the engine is cranking. The actual and the desired injection actuation pressures should be approximately the same value. Some fluctuation in the actual injection actuation pressure is normal. If the fluctuation is extreme, there may be a possible problem with the compensator control valve or the hydraulic pump. A customized ET screen like this one is helpful for checking the Injection Actuation Pressure System.

Injection Actuation Pressure System	
Parameter Reading	Parameter Description
psi	Desired Injection Actuation Pressure
psi	Injection Actuation Pressure
%	Injection Actuation Current
rpm	Engine Speed

An optional parameter for this screen would be the engine oil temperature.

Here are four possible situations that would not allow the engine to start or to start but not run properly:

Injection Actuation Current is 100% and Actual Injection Actuation Pressure is Low

If the injection actuation current is at 100% and the actual injection actuation pressure is low, there is possibly a leak in the injector or the jumper tube that provides the oil to the injector. The minimum pressure required to enable the injector is approximately 4500 kPa (650 psi) and the normal operating range is 5000 to 21 000 kPa (725 to 3100 psi). The pressure must be 5000 kPa (725 psi) for the engine to start. 1800 kPa (260 psi) is the default value for the sensor.

When inspecting the engine for oil leaks, first check the engine when it is cold by just cranking and not allowing the engine to start. If there are no visible leaks, then run the engine (if it will start) until it reaches operating temperature. Leaks will be much more visible when the oil is warm and under pressure.

⚠ WARNING

Hot oil and hot components can cause personal injury. Do not allow hot oil or hot components to contact the skin.

First remove the valve covers and disable all unit injectors using an ET service tool, ground level shutdown switch, or by disconnecting the injector wiring in the valve cover base. Then crank the engine and observe each injector and the joints where it connects to the jumper tube. Also check the spill port, which is on the top of older injectors and on the bottom of newer injectors. An oil drip is acceptable, but a pencil-sized flow would be considered a large leak and could prevent the engine from starting. If an injector is leaking from the spill port, the injector should be replaced. If there is a massive leak in the joint between the jumper tube and the manifold, remove the jumper tube, check the seals and replace any seals that are damaged. Then reinstall the jumper tube and torque the bolts. Refer to Special Instruction REHS0116-02 for the complete procedures, specifications and the tools required for removing and installing injectors.

Injection Actuation Current is 100% and Actual Injection Actuation Pressure Is Normal

If the injection actuation current is at 60% to 100% and the injection actuation pressure is normal, there may be a small leak, which is large enough to cause the engine to not run properly. The leak can be made more apparent by performing the injection actuation pressure override test, which will raise the injection actuation pressure.

The engine should be at operation temperature before starting the test. This will make a small leak more obvious. Disable both injectors under the valve cover where you suspect the leak may be and run the engine. Using ET, increase the desired injection actuation pressure incrementally to the maximum value of approximately 3300 psi. Observe the injectors, the jumper tube connections and the injector spill ports to identify the source of the leak. When the source of the leak is identified, use the repair procedures mentioned in Injection Actuation Current is 100% and Actual Injection Actuation Pressure is Low.

Injection Actuation Current is Normal (20%-50%) and Actual Injection Actuation Pressure is Low

If the injection actuation current is normal (20%-50%) and the actual injection actuation pressure is low, the screw in the compensator control valve may have backed out. On older pumps a compensator plug can be installed to correct this situation. Refer to Special Instruction REHS0282-01 for the installation procedure for the appropriate length compensator standby plug from the 161-8627 Plug Kit. Another item to check is the injection actuation pressure control valve for proper operation. The 166-5985 Pump Compensator is also a serviceable part. Refer to Service Magazine; "Compensator and Socket Head Bolts For 3408E and 3412E Hydraulically Actuated Electronically Controlled Unit Injector (HEUI) Hydraulic Pump Now Available"; November 16, 1998; Page 28-29.

Air In Fuel System

A loose injector can allow combustion gas to leak into the fuel system and cause the engine to misfire. If the base of the injector does not seal against the bottom of the injector sleeve, combustion gas can leak into the body of the injector and then into the fuel. The following method can be used to check for air in the system. With the engine running, grasp the fuel return lines at the rear of the engine. Air in the fuel system will cause pressure pulsations in the return hoses. The hoses will expand and contract with each pressure spike. If one hose has higher spikes than the other does, this is a good indication that the corresponding cylinder bank has the loose injector. The other injectors downstream from the loose injector will probably also misfire. Verify that the clamps holding the injectors are torqued to $47 \pm 9 \text{ N}\cdot\text{m}$ ($35 \pm 7 \text{ lb}\cdot\text{ft}$). Refer to Special Instruction REHS0116-02 for installation and torque procedures for the injector.

Remember these tips to avoid leaks associated with the injectors:

- Check for leaks when the engine is cold, and then check when the engine is at operating temperature.
- Leaks will be much more visible when the oil is warm and under pressure.
- Be sure each injector clamp is properly torqued.

- Replace the seals on all mating surfaces of the jumper tube.
- Use the correct torque sequence and specification on the jumper tube.
- Refer to Special Instruction REHS0116-02 for the correct injector removal and installation procedure.

Once the leak has been identified and repaired, verify the actual injection pressure and current.

Correct Procedure for Installing Hydraulically Actuated Electronic Unit Injectors (HEUI) (08-25-97)

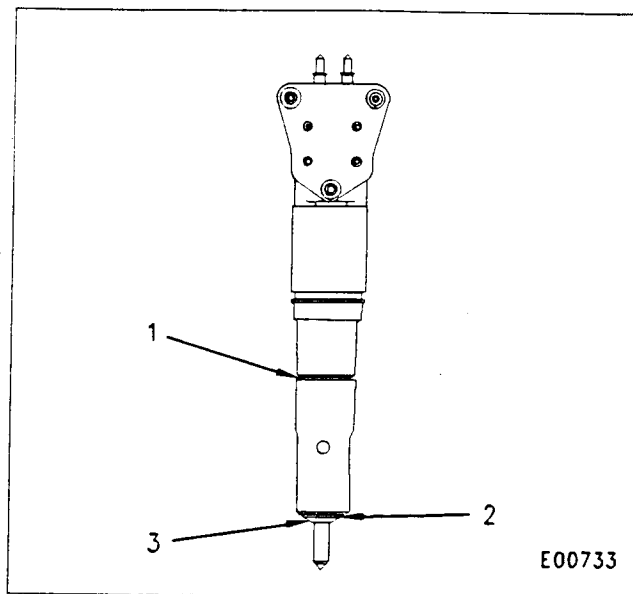
1290

**D9R (7TL, 8BL),
D10R (3KR) Track-Type Tractors;
24H (7KK) Motor Graders;
631E (1AB),
633E (2PS),
637E (1FB),
651E (4YR),
657E (5YR, 6PR, 6TR, 7KR) Wheel-Tractor
Scrapers;
769D (5TR),
771D (6JR),
773D (7ER),
775D (6KR) Off-Highway Trucks;
834B (7BR) Wheel Tractors;
836 (7FR) Compactors;
988F (2ZR),
990 (4FR) Wheel Loaders;
5110 (7GN) Excavators;
PM-565 (3TK) Cold Planers**

Reference: Special Instruction, REHS0116, "Removal And Installation Of Hydraulic Electronic Unit Injectors (HEUI)"

These machines are powered by 3408E (99C) or 3412E (80M) Engines. These engines are equipped with HEUI Fuel Systems. In order to avoid damaging the unit injectors and subsequent possible major engine damage, use the following procedure when installing HEUI Injectors.

Installation of HEUI Injectors



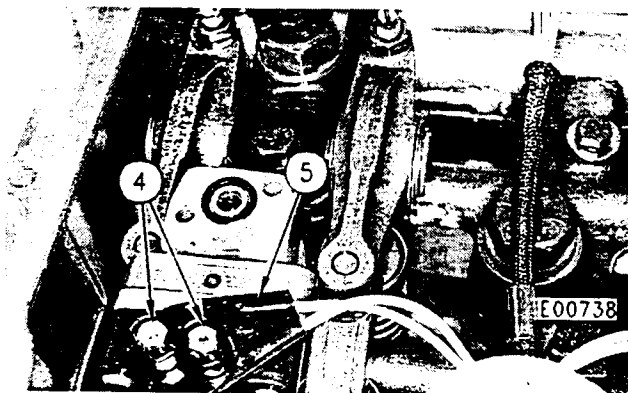
(1) O-ring seal. (2) O-ring seal. (3) Tapered seat.

1. Clean the carbon from:
 - The tapered Seat (3) on the injector.

NOTICE

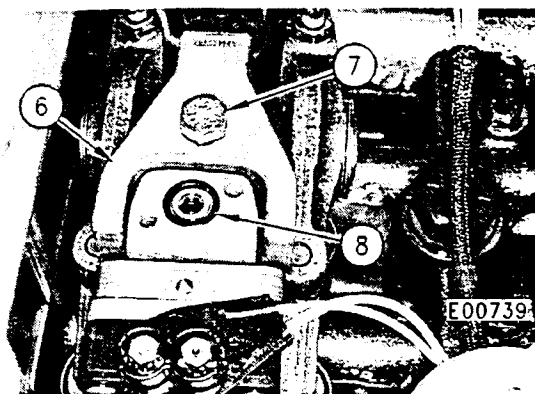
If you are cleaning the tapered Seat (3) on the injector with a wire brush, do not let the wire brush contact the tip of the injector. A wire brush may damage the tip of the injector.

- The tapered seat in the injector sleeve.
2. Install new O-ring seals (1) and (2).
 3. Lubricate the O-ring seals (1) and (2), and the injector sleeve bore lightly with clean engine oil. Install the HEUI Injector in its original location in the injector sleeve.



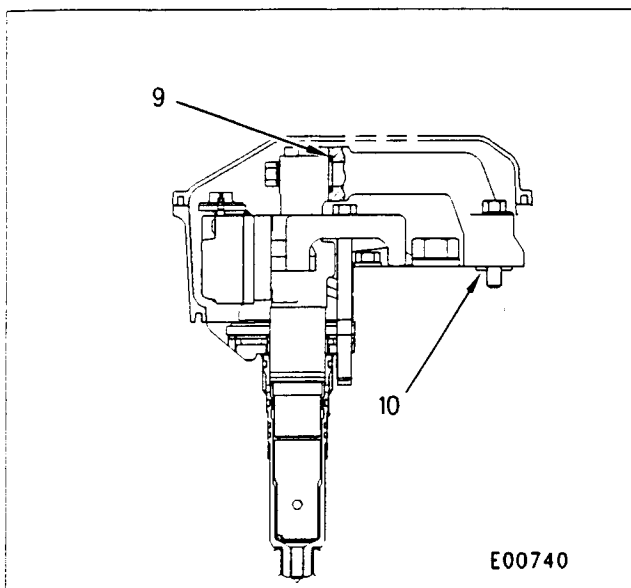
View of the wire assembly. (4) Cap and nut assemblies. (5) Wire assembly.

4. Connect the wire assembly (5). Install the cap assembly and nuts (4). Tighten the nuts to a torque of $1.70 \pm 0.25 \text{ N}\cdot\text{m}$ ($15 \pm 3 \text{ in lb}$).



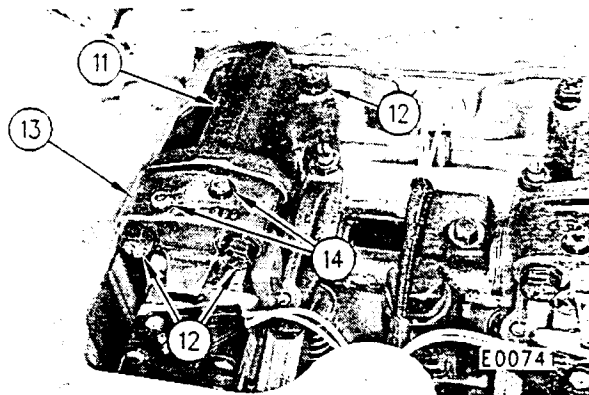
(6) View of the clamp. (7) Bolt. (8) O-ring seal.

5. Position the clamp (6) and tighten the bolt (7) to $47 \pm 9 \text{ N}\cdot\text{m}$ ($35 \pm 7 \text{ lb ft}$).



(9) View of the O-ring seals installed in the jumper tube. (10) O-ring seals installed in the rocker arm base.

6. Install the O-ring seal (8) and the O-ring seals (9) in the jumper tube and in the rocker arm base (10).



(11) View of the jumper tube. (12) Bolts (one bolt hidden in this view). (13) Adapter. (14) Socket head cap screws.

7. Place the jumper tube (11) and adapter (13) in position.

NOTICE

If the adapter was previously installed on the HEUI Injector, loosen the socket head cap screws. Failure to loosen the socket head cap screws before continuing with Step 8 can result in HEUI Injector failure.

8. Install the socket head cap screws (14) and four bolts (12).

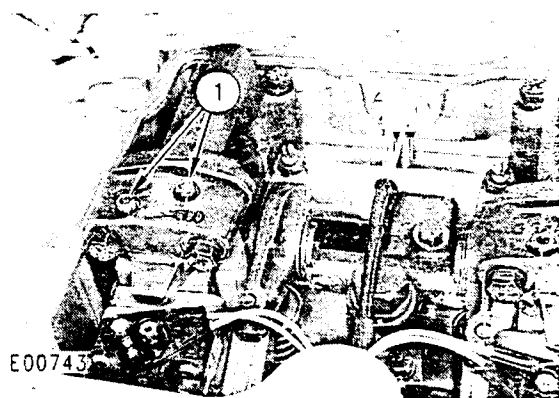
Note: The objective at this point in the procedure is to bring all the mating faces into complete contact and alignment before starting the final torque procedure.

NOTICE

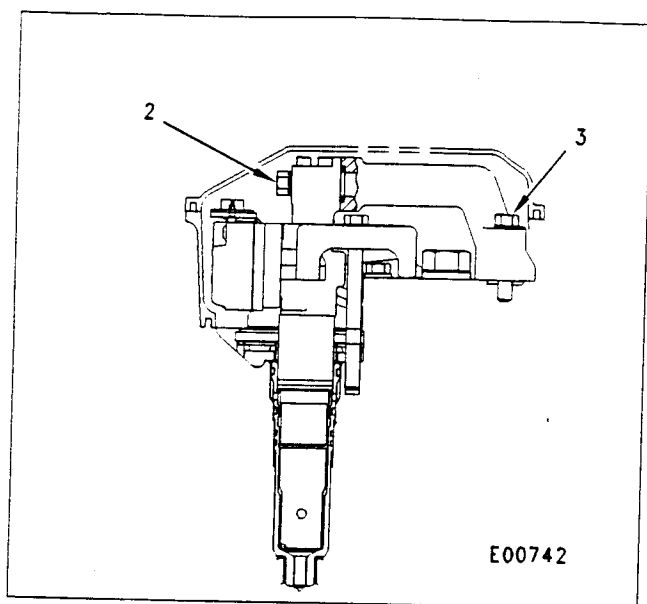
Failure to use the correct torquing procedure may cause injector damage and subsequent major engine damage.

Torquing Procedure

Tighten the two socket head cap screws (1) and the two horizontal bolts (2) and two vertical bolts (3) finger tight to bring the mating surfaces together and into alignment.



Socket head cap screws (1).



(2) Two bolts (horizontal). (3) Two bolts (vertical).

1. Tighten the socket head cap screws (1) to an initial torque of $1 \pm 0.2 \text{ N}\cdot\text{m}$ ($10 \pm 2 \text{ lb in}$).
2. Tighten the horizontal bolts (2) to an initial torque of $5 \pm 3 \text{ N}\cdot\text{m}$ ($4 \pm 2 \text{ lb ft}$).
3. Tighten the vertical bolts (3) to an initial torque of $5 \pm 3 \text{ N}\cdot\text{m}$ ($4 \pm 2 \text{ lb ft}$).
4. Tighten the socket head cap screws (1) to the final torque of $12 \pm 3 \text{ N}\cdot\text{m}$ ($9 \pm 2 \text{ lb ft}$).
5. Tighten the horizontal bolts (2) to the final torque of $47 \pm 9 \text{ N}\cdot\text{m}$ ($35 \pm 7 \text{ lb ft}$).
6. Tighten the vertical bolts (3) to the final torque of $47 \pm 9 \text{ N}\cdot\text{m}$ ($35 \pm 7 \text{ lb ft}$).
7. Repeat the above installation procedure for all of the HEUI Injectors.
8. Check the system for leaks (crank with the injection disabled). Then check the hydraulic pressure (compare with the desired pressure).

Cranking with the Injection Disabled

Cranking with the injection disabled may be performed by one of the following methods:

- Disconnect the injection harness for the cylinders that have the valve cover removed. Let the engine idle and visually inspect the injector components for high pressure oil leaks.
- Activate the system "Crank Without Inject" if the option is available on your machine. On track-type tractors a Crank Without Inject (CWOI) plug can be assembled in the engine harness. On off-highway trucks the "Ground-Level Shutdown" can be activated if available.

- On machines equipped with Electronic Technician (ET) or Electronic Control Analyzer and Programmer (ECAP), injection may be disabled by interactive diagnostics. The engine can be left idling while the injector components on the affected cylinders are visually examined for high pressure leakage.

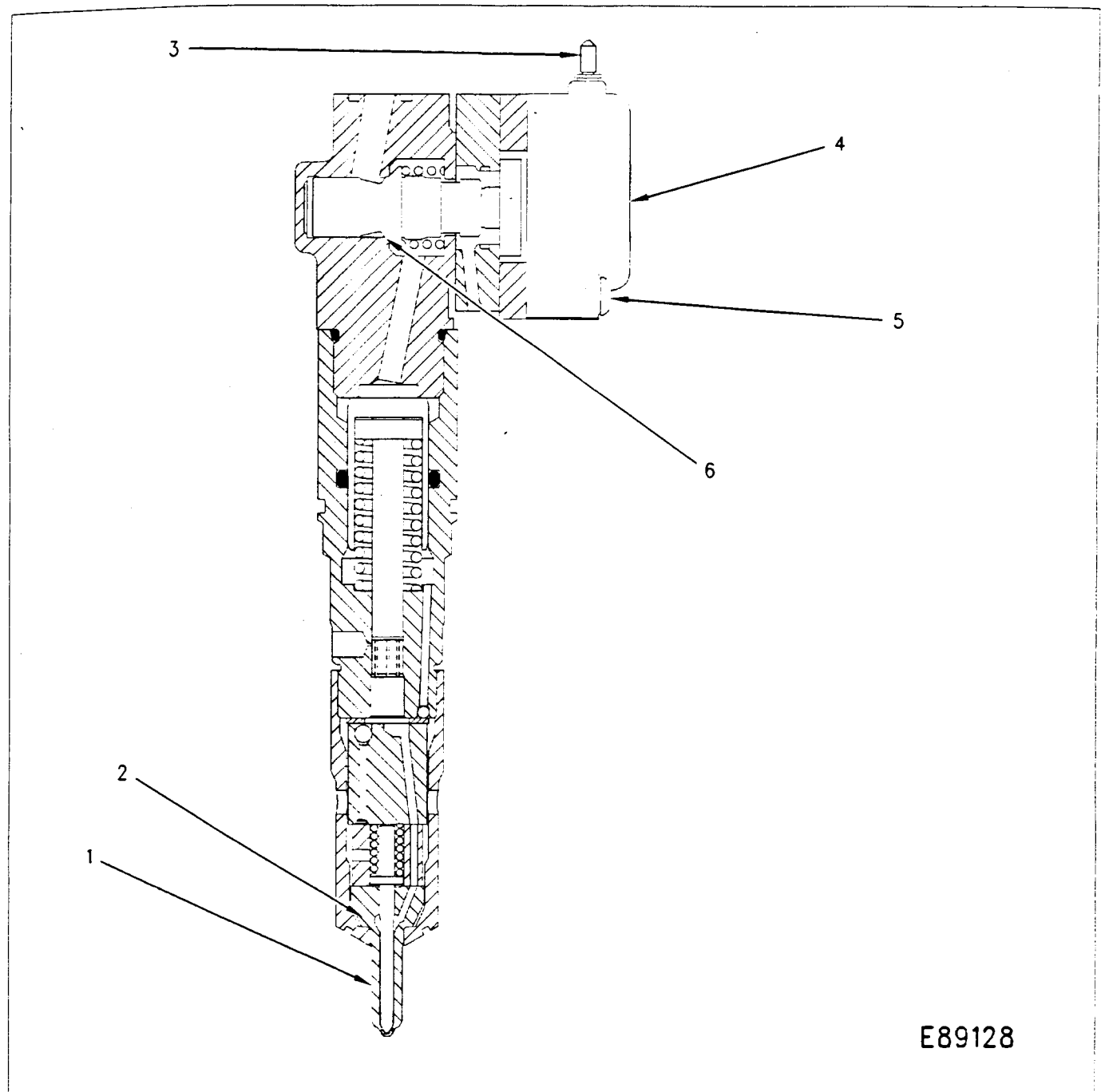
Note: A separate power supply may be required for ECAP and/or the Communications Adapter. The power supply keeps the injectors fully powered in CYL-CUTOUT mode during cranking.

New Injector is Now Available (06-07-99)

1290

836 (7FR386-Up) Compactors;
5110 (8HN, 7GN) Excavators;
24H (7KK67-Up) Motor Graders;
769D (5TR1026-Up, 5SS75-Up),
771D (6JR302-Up, 6YS72-Up),
773D (7ER948-Up, 7CS76-Up),
775D (6KR374-Up, 8AS81-Up)
Off-Highway Trucks;
PM-565 (3TK113-Up),
PM-565B (8GS151-Up) Cold Planers;
D9R (8BL1368-Up, 7TL1080, 7TL1083-Up),
D10R (3KR1212-Up) Track-Type Tractors;
988F (2ZR1572-Up),
990 (4FR372-Up) Wheel Loaders;
834B (7BR662-Up),
844 (2KZ) Wheel Tractors;
631E Series II (1AB1842-Up, 1NB1433-Up),
633E Series II (2PS314-Up),
637E Series II (1FB7756-Up),
651E (4YR221-Up),
657E (5YR283-Up, 6PR103-Up, 6TR215-Up,
7KR232-Up) Scrapers

Description Of Change: Several improvements have been made to increase the reliability of the unit injectors used in the 3408E and 3412E Engines. The new 174-7526 Injector has improvements to address the following problems:



E89128

Lower Portion of Nozzle Tip (1). Nozzle Tip at End of Nozzle Case (2). Terminal Post (3). Solenoid (4). Armature Screw (5). Lower Poppet Seat (6).

- 1.) Nozzle tip splitting due to tip fatigue.
- 2.) Nozzle tip breakage due to side load from improper installation.
- 3.) Solenoid post loosening due to vibration.

- 4.) Solenoid failure due to internal shorting.
- 5.) Armature screw loosening due to manual torque control.
- 6.) Low power complaints due to cavitation erosion of the injector lower poppet seat.

1.) Nozzle tip splitting due to fatigue was observed on some early engines. This failure typically resulted in the tip splitting through an orifice hole and piece of the tip near the end breaking out. This problem was eliminated through several design and process changes which increased the tip wall strength and reduced the check impact at the end of injection. Tip strength has been increased by using a thicker tip wall. Check impact load has been reduced by a design change to increase the check damping and to reduce the check lift.

2.) Nozzle tip breakage where the entire shank portion of the tip breaks off near the end of the nozzle case has been seen on some field-replaced injectors. This is a result of side-loading on the tip at injector installation, which occurs when carbon deposits in the tip hole of the injector sleeve are not properly removed. This problem has been addressed by implementing a new plug gauge which is used prior to installing the injector, and ensures that adequate clearance is available at the point of use. In addition, a new cleaning brush was released to facilitate cleaning the hole, instructions were improved, and a special warning wrapper (with international symbols) was affixed to each service injector to alert the installer to the proper procedures. New packaging was also implemented to better protect service injectors during shipping and handling.

3.) Solenoid post loosening can occur due to fatigue from prolonged engine vibration. The original containment action to reduce the effect of the vibration was to add a rubber grommet to reduce terminal post movement. The permanent corrective action was to add additional epoxy material to the post. This provides a significant increase in strength and eliminates the need for the rubber grommet.

4.) Solenoid failure due to internal shorting was caused by frayed wire insulation from prolonged exposure to engine vibration. This problem was addressed by using wire with a bondable insulation. This new insulation is heat bonded with insulation from adjacent wires forming a single mass that is much stronger and vibration resistant.

5.) Armature screw loosening occurred to some injectors due to a manual torquing process used during assembly. This manual process has been eliminated and replaced by a computer controlled automated torquing process. The new automated process assures the correct clamping load on the armature to prevent armature screw loosening.

6.) Low power complaints due to cavitation leakage of the injector lower poppet seat has been addressed through new software to reduce actuation pressure during high speed, low fuel delivery conditions. Excessive actuation pressure at low fuel rate conditions cause a vacuum bubble to form at the lower poppet seat when the poppet closes. Continued exposure to the implosion of the vacuum bubbles eventually causes cavitation damage to the lower poppet seat. This damage allows excessive leakage of actuation pressure, low fuel delivery and a low power complaint.

Adaptable To: The new 174-7526 Injector is a direct replacement for the former 159-0835, 138-8754, and 131-3098 Injectors on the engines in the above machines. The former injectors have been canceled. ■

Part Numbers for Current Production Water Pump Groups (03-09-98)

1361

D9R (7TL, 8BL)
D10R (3KR) Track-Type Tractors;
73D (1GW) Underground Trucks;
769D (5TR, 5SS),
771D (6JR),
773D (7ER),
775D (6KR) Off-Highway Trucks;
631E (1AB),
637E (1FB),
651E (4YR),
657E (5YR, 6TR, 6PR, 7KR) Wheel Tractors;
834B (7BR) Wheel Tractors;
836 (7 FR) Compactors;
988F (2ZR),
990 (4FR) Wheel Loaders

Description Of Change: Water pump group part numbers are broken down by part number and effective serial numbers in the above machines powered by 3408E (99C1958-Up), and 3412E (80M1091-Up) Engines.

Adaptable To: See the chart for effectivity.

Effectivity Chart For Water Pump Groups				
Machine Model	Engine Model	Part Number	Serial Number	Description
D9R	3408E	137-1338 Production 0R-4679 Parts Service	7TL804-836-Up 8BL1020-Up	Track-Type Tractors
631E			1AB1711-Up	Wheel Tractors
637E			1FB697-Up	
657E			7KR226-7 7KR230-Up	Wheel Scrapers
			6PR102-Up	
769D			5TR570-Up 5SS69-Up	Off-Highway Trucks
771D			6JR149-Up	
834B			7BR605-Up	Wheel Tractors
836			7FR282-Up	Compactors
988F			2ZR717-Up	Wheel Loaders
D10R	3412E	137-1339 Production 0R-4680 Parts Service	3KR752-Up	Track-Type Tractors
73D			1GW118-Up	Off-Highway Trucks
773D			7ER431-Up	
775D			6KR104-Up	
651E			4YR196-Up	Wheel Tractors
657E			5YR233-Up 6TR206-Up	
			4FR244-Up	Wheel Loaders
990				

New Bracket Protects Flasher Control

1430

**613C-II (8LJ),
615C-II (9XG),
611 (6SZ) Wheel Tractors**

Description Of Change: The flasher control has been relocated and mounted on a new bracket to protect it from accidental foot contact.

Adaptable To: The change to the 2T-3374 Signal Lighting Group adds a new 8I-2083 Bracket and two 9S-2437 Screws and is effective with 613C-II (8LJ1972) and 615C-II (9XG1266) Wheel Tractors. The change to the 8I-2074 Signal Lighting Group adds a new 8I-2083 Bracket and two 9S-2437 Screws and is effective with 611 (6SZ191) Wheel Tractors. The changes are adaptable to earlier machines by the following procedure.

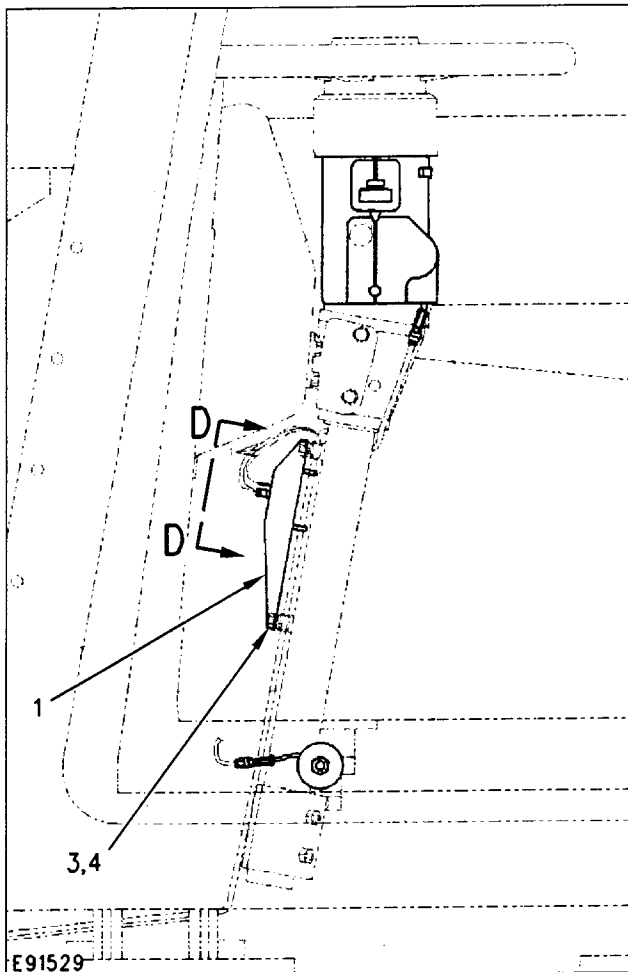


Illustration 1. Typical Signal Lighting Group.

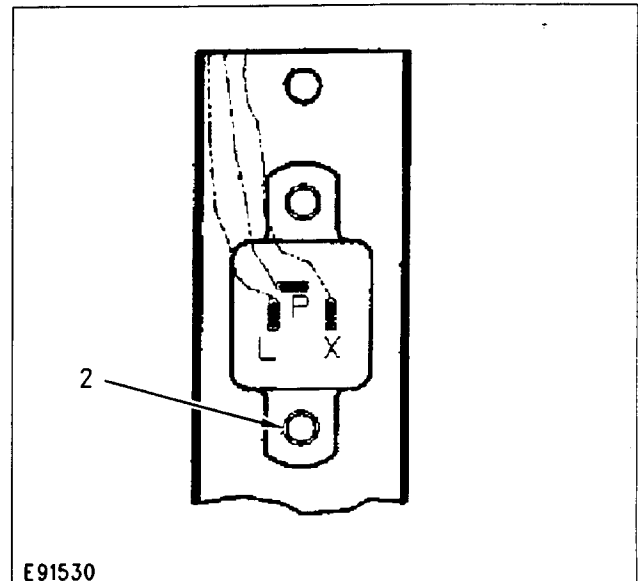


Illustration 2. View D-D from Illustration 1.

Procedure to Adapt Earlier Machines

1. Remove flasher control from the underside of the dash.
2. Mount flasher control to the new 8I-2083 Bracket (item 1) using two 9S-2437 Self-Tapping Screws (item 2).
3. Mount the new 8I-2083 Bracket (item 1) to the two existing bosses located on the back side of the steering column using the two existing 8T-9371 Bolts (item 3) and the two existing 8T-4896 Washers (item 4).

New Wheel Improves Bearing and Wheel Service Life

4208, 4006, 4051

615C-II (9XG) Wheel Tractors

Description Of Change: The new wheel changes the dimensions and tolerances to provide a tighter bearing fit to reduce wheel bearing spinning. Also, a new design of the wheel fills in the area of the wheel between the inner and outer bearing lands to provide increased bearing support and to eliminate cracking of the bearing flange.

Adaptable To: The new 153-6458 Wheel is a direct replacement for the former 8V-6398 Wheel. The change to the 4V-5303 Final Drive, Brake and Wheel Group is effective with 615C-II (9XG1034) Wheel Tractors. The new design of the 135-6458 Wheel is effective with 615C-II (9XG1042) Wheel Tractors.

New Injector Sleeve Bore Gauge and Tube Brush Available for Injector Sleeve Bore; New Grommet Available for Unit Injector Electrical Connection (10-19-98)

1713, 1290

D9R (7TL, 8BL),
D10R (3KR) Track-Type Tractors;
24H (7KK) Motor Graders;
73D (1GW) Underground Truck;
631E (1AB),
633E (2PS),
637E (1FB),
651E (4YR),
657E (5YR, 6PR, 6TR, 7KR) Wheel-Tractor Scrapers;
769D (5TR),
771D (6JR),
773D (7ER, 7CS),
775D (6KR) Off-Highway Trucks;
834B (7BR),
844 (2KZ) Wheel Tractors;
836 (7FR) Compactors;
988F (2ZR),
990 (4FR) Wheel Loaders;
PM-565 (3TK) Cold Planers

All carbon deposits should be removed from the injector sleeve bore and the angled surface of the sleeve before installing injectors in 3408E or 3412E Machine Engines. Cleanliness is essential to properly seal the injector in the sleeve and to prevent tip damage or injector failure due to leakage of combustion gas into the fuel passage.

The 164-5927 Tube Brush and the 164-5924 Injector Sleeve Bore Gauge are now available. The tube brush is used to clean the injector bore. The injector sleeve bore gauge is used to verify that the bore of the injector sleeve is thoroughly clean. For additional details you can order the Service Tool Announcement, form number NEHG4893.

The 161-3568 Grommet is also now available. Once the injector is installed in the injector sleeve, place a grommet on each of the two posts of the injector solenoid prior to installing the injector wiring harness.

The steps for removing and installing the injectors in 3408E and 3412E Machine Engines are outlined in Special Instruction REHS0116-02, "Removal And Installation Of HEUI Injectors". Failure to follow the procedures in the Special Instruction, Version 02, and to use the gauge to verify the cleanliness of the sleeve bore could result in injector tip breakage and severe engine damage.

New Secondary Brake Assemblies Are Now Used In Certain Pneumatic Compactors

4061, 4351

PS-150B (3XR300-Up),
PS-200B (5JR234-Up),
PF-290B (1XW63-Up),
PS-360B (9LS114-Up) Pneumatic Compactors

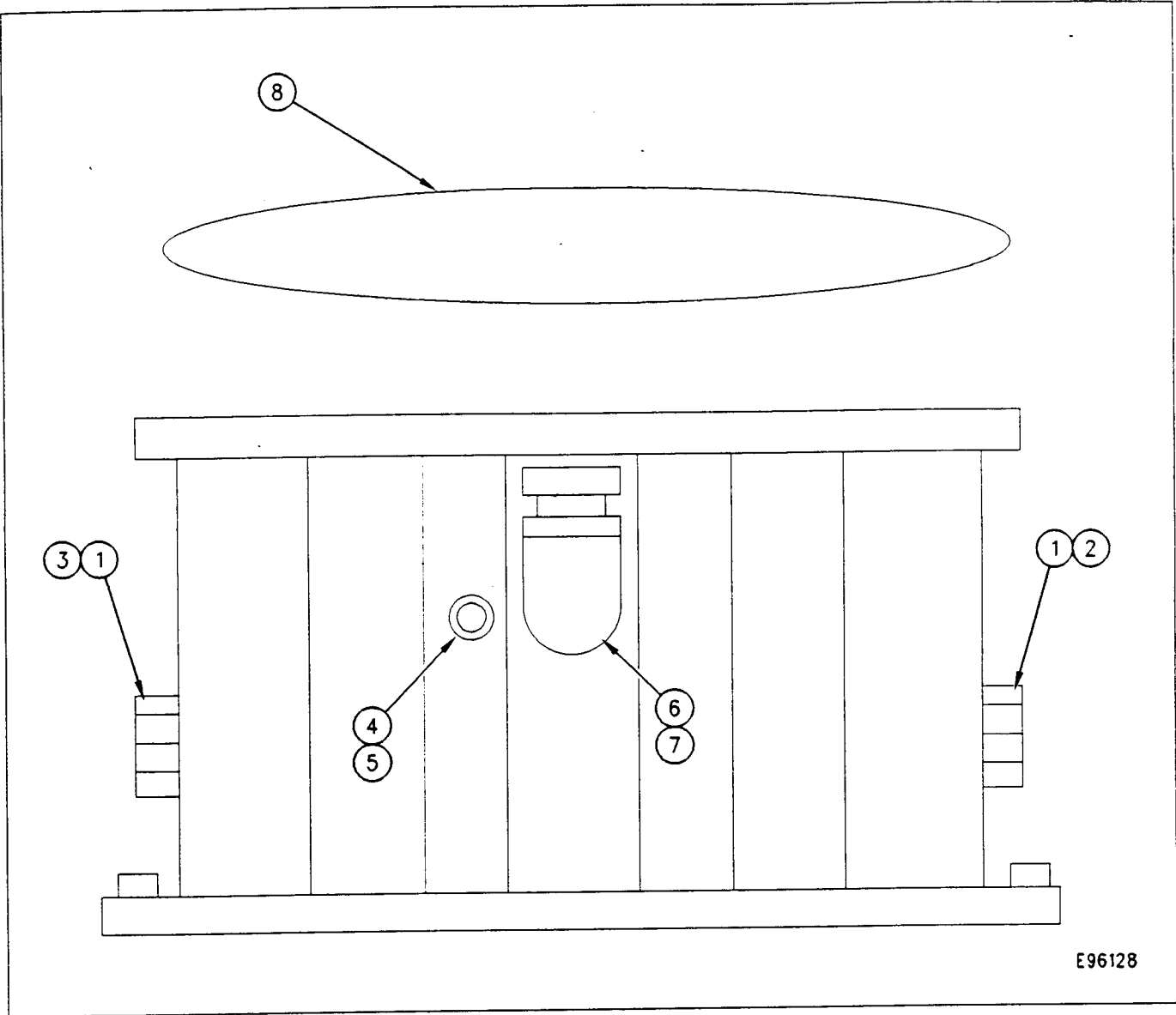
Description Of Change: The former 122-7119 Brakes have been canceled and replaced by the new 171-2134 Brakes. The new brakes are a direct replacement for the former 122-7119 Brakes. Changes to the new brake group include the following:

1. The upper bearing seal has been removed and the oil capacity increased from 353 mL (12 oz.) to 474 mL (16 oz.) of 50 wt. MTO.
2. An o-ring seal has been added to the propel motor mounting flange to provide an oil seal between the brake and the propel motor.
3. The housing of the new 171-2134 Brake is now machined to accommodate the oil seal on the motor mounting flange.
4. A sight glass has been added to the upper brake housing to allow for visual inspection of the oil level. The oil level should be maintained at the mid point of the sight glass.
5. The filter and breather fittings have been combined and relocated in the upper housing.
6. The piston seals have been changed to "Viton" seals to improve the heat tolerance of the seals and reduce piston seal leakage into the brake disc cavity.

Adaptable To: PS-150B (3XR1-299), PS-200B (5JR1-233), PF-290B (1XW1-62), PS-360B (9LS1-113).

When installing the new brake, new fittings and seals will need to be installed. See the following chart and illustration for required part numbers and their locations.

Parts Required For Installation Of The 171-2134 Brake Group		
Part Number	Description	Quantity Per Brake
117-8801	O-Ring Seal	1
003-2143	Elbow	1
171-2972	Indicator-Oil	1
171-5286	Breather	1
5P-7812	Seal	1
8L-2786	Seal	2
9S-4185	Plug	1
9S-8001	Plug	1



E96128

(1) 8L-2786 Seal, (2) 171-2972 Indicator, (3) 9S-4185 Plug, (4) 5P-7812 Seal, (5) 9S-8001 Plug, (6) 003-2143 Elbow, (7) 171-5286 Breather, (8) 117-8801 Seal, (to be installed between the propel motor and the brake).

Note: The right-hand brake is shown. For the left-hand brake, reverse items 2 and 3 so indicators face towards the outside of the machine.



Compensator and Socket Head Bolts for 3408E and 3412E Hydraulically Actuated Electronically Controlled Unit Injector (HEUI) Hydraulic Pump Now Available (11-16-98)

1714

**836 (7FR) Compactors;
5110 (8HN, 7GN) Excavators;
24H (7KK) Motor Graders;
769D (5TR),
771D (6JR),
773D (7ER),
775D (6KR) Off-Highway Trucks;
PM-565 (3TK113-Up) Cold Planers;
D9R (8BL830-Up, 7TL557-Up),
D10R (3KR) Track-Type Tractors;
988F (2ZR),
990 (4FR) Wheel Loaders;
834B (7BR) Wheel Tractors;
631E Series II (1AB1640-Up, 1NB1390-Up),
633E Series II (2PS),
637E Series II (1FB532),
651E (4YR),
657E (5YR, 6PR, 6TR, 7KR) Scrapers**

Description Of Change: The above machines are powered by 3408E and 3412E Engines equipped with HEUI Fuel Systems. The HEUI Hydraulic Pump was previously available only as a completely assembled pump. Along with several previously released serviceable parts of the pump, the pump compensator and the socket head bolts are now available for parts service.

Adaptable To: The HEUI 166-5985, Pump Compensator, and 164-0759, Socket Head Bolts, are now available for the HEUI Hydraulic Pump. The torque for the socket head bolts is $7.45 \pm 0.65 \text{ N}\cdot\text{m}$ ($66 \pm 6 \text{ lb in}$).

The following is a list of references that may be helpful when reworking the HEUI Hydraulic Pump.

Test Procedure; NEHT6160; HEUI Equipped Engines.

Video; LEVN4245; Disassembly and Assembly of the 144-0835 Unit Injector Hydraulic Pump.

Special Instruction; REHS0192-03; Disassembly and Assembly of the 144-0835 Unit Injector Hydraulic Pump.

Special Instruction; REHS0282-01; Installation of the HEUI Pump Compensator Standby Plug for 3408E and 3412E Engines.

The following is a current list of the HEUI Unit Injector Hydraulic Pump's serviceable parts.

Part No.	Description
166-5985	Compensator
164-0759	Socket Head Bolts
161-8627	Plug Kit
107-0677	IAP Control Valve
144-0837	Unit Injector Hydraulic Pump Group
149-1950	Fuel Transfer Pump Group
0S-1617	Bolt (5/16)
9S-8001	Plug
9S-8002	Plug
9S-8004	Plug
9S-4180	Plug
9S-8007	Plug
138-4309	Fitting
138-4311	Spring
138-4313	Valve
117-1620	Coupling
138-6256	Seal Kit
154-6732	Pump Kit
154-6734	Bearing
154-6735	Pintle Bearing
033-6043	O-Ring (for pressure limiter plug)
109-3206	O-Ring (for load sensing plug)
9X-7680	O-Ring (3 between compensator and adapter block) (3 between adapter block and valve block)
033-6039	O-Ring (between adapter block and valve block)
135-2652	O-Ring (between adapter block and compensator)
109-9685	O-Ring (for the two plugs opposite the adjusting plugs)

New Plug Kit Improves Injection Actuation Pressure During Engine Cranking (09-21-98)

1714-012

**D9N (6XJ1-Up),
D9R (7TL1-Up, 8BL1-Up),
D10R (3KR1-Up) Track-Type Tractors;
24H (7KK1-Up) Motor Grader;
PM-565 (3TK1-Up),
PM-565B (8GS1-Up) Paving Equipment;
631E Series II (1AB1446-Up, 1NB872-Up),
633E Series II (2PS1-Up),
637E Series II (1FB532-Up),
651E (4YR1-Up),
657E (5YR1-Up, 6PR1-Up, 6TR1-Up, 7KR1-Up),
834B (7BR1-Up),
844 (2KZ) Wheel Tractors;
769D (5TR1-Up, 5SS1-Up),
771D (6JR1-Up, 6YS1-Up),
773D (7ER1-Up, 7CS1-Up),
775D (8AS1-Up, 6KR1-Up) Off-Highway Trucks;
836 (7FR1-Up) Compactor;
988F (2ZR1-Up),
990 (4FR1-Up) Wheel Loaders;
5110 (7GN1-Up, 8HN) Excavators**

Reference: Special Instruction, REHS0282, "Installation Procedure of the HEUI Pump Compensator Standby Plug for 3408E and 3412E"

Description Of Change: The HEUI Pump Compensator Plug regulates the injection actuation pressure between 4.8 and 6.0 MPa (696 to 870 psi) during engine cranking. The new one piece compensator plug replaces the allen head plug and the load sensing screw. The compensator plug is part of a plug kit.

Adaptable To: The 161-8627 Plug Kit is adaptable to the 3408E or 3412E Engines in the above machines.

If the HEUI Pump is not providing the required injection actuation pressure during engine cranking, perform the following procedure:

1. Connect the diagnostic equipment (ET or ECAP) to the Electronic Control Module (ECM) in order to monitor the injection actuation pressure.
2. Unplug the injection actuation pressure control valve.
3. Crank the engine and note the injection actuation pressure.
4. Remove the allen head plug.
5. Turn the load sensing screw in approximately two turns.

6. Crank the engine and note the injection actuation pressure.

7. Reconnect the injection actuation pressure control valve when the procedure is completed.

If the injection actuation pressure increases after the load sensing screw is turned, installing the proper one piece compensator plug should correct the condition. Follow the procedure in the Reference publication for installing the appropriate length compensator plug from the 161-8627 Plug Kit.

The following chart lists the parts that are included in the 161-8627 Plug Kit.

161-8627 Plug Kit Parts List				
Quantity	Part Number	Description	Label	Length
9	109-3206	O-rings		
1	163-6196	Plug	J	35.23 mm (1.387 inch)
1	163-5592	Plug	G	34.90 mm (1.374 inch)
1	161-4369	Plug	A	34.57 mm (1.361 inch)
1	161-4371	Plug	B	34.24 mm (1.348 inch)
1	161-4372	Plug	C	33.91 mm (1.335 inch)
1	161-4373	Plug	D	33.58 mm (1.322 inch)
1	161-4374	Plug	E	33.25 mm (1.309 inch)
1	163-5593	Plug	F	32.92 mm (1.296 inch)
1	163-6195	Plug	H	32.59 mm (1.283 inch)



1700 Fuel System (Continuation of Category 1250)

Procedure to Clean Area Around Injector Case and Sleeve Bore During Unit Injector Replacement (06-24-96)

1713

Caterpillar Machines Powered by 3408E (7PR) and 3412E (4CR) Engines

During unit injector replacement in the above engines, cleanliness is very important when dealing with the area around the unit injector case and sleeve bore. All carbon deposits should be removed from the unit injector case around, and including, the lower O-ring seal groove. Carbon deposits should also be removed from the 120 degree included angle surface at the bottom of the unit injector sleeve. Failure to properly clean these areas may cause an improper seal at the lower unit injector O-ring. This could directly result in unit injector failure due to leakage of combustion gas into the fuel passage.

Fine grade "Scotch Brite" material is the preferred cleaning material. It is available from the Tools And Shop Products Guide in roll form as 1U-5512 Cut/Polish Roll and sheet form as 8T-7765 Hand Pad.

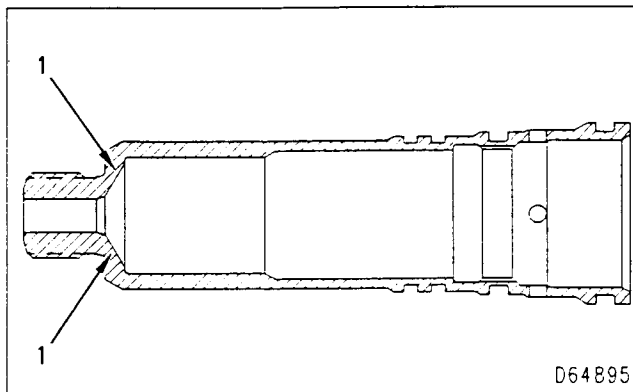


Illustration 1: Typical Unit Fuel Injection Pump Sleeve. (1) 120 degree included angle surface where the lower injector O-ring seals.

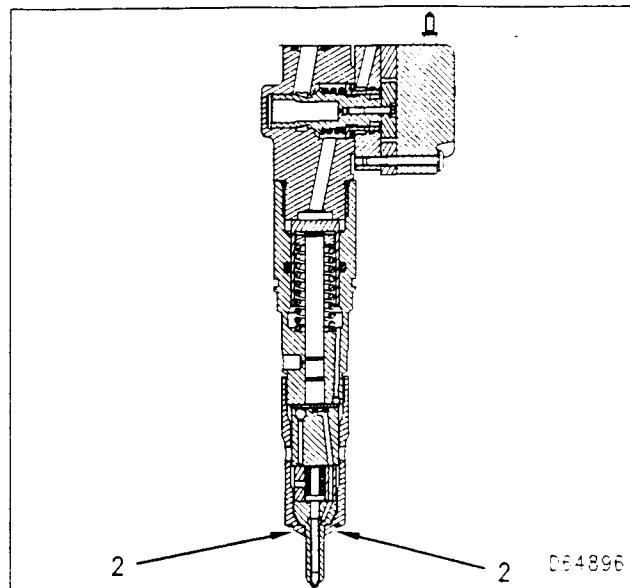


Illustration 2: Typical Unit Fuel Injector. Entire lower portion of injector should be clean, especially (2) lower O-ring groove and adjacent surface.

The preferred method of cleaning the sleeve bore is to:

- Place a 38 mm (1.5 in) square piece of "Scotch Brite" material on the end of 9U-6862 Small Tapered Brush.
- Hold and twist the brush with 4C-5027 Tap Wrench against the lower sleeve bore surface.

Note: The use of power tools to rotate the material should not be necessary since carbon in this area is not as difficult to remove as at locations exposed to higher temperatures.

- The surface should be cleaned until it is smooth and shiny. The entire sleeve bore should, then, be cleaned to remove any loose carbon particles.

Note: It is advantageous to use 4C-6774 Vacuum Kit Gun, which is operated by compressed air, to clean the bore.

The 154-6732 Pump Kit is Available to Help Service the Unit Injector Hydraulic Pump Group on 3408E (99C) and 3412E (80M) Machine Engines (01-26-98)

1714

**D9R (7TL, 8BL),
D10R (3KR) Track-Type Tractors;
24H (7KK) Motor Graders;
631E (1AB),
633E (2PS),
637E (1FB),
651E (4YR),
657E (5YR, 6PR, 6TR, 7KR) Wheel-Tractor
Scrapers;
769D (5TR),
771D (6JR),
773D (7ER),
775D (6KR) Off-Highway Trucks;
834B (7BR) Wheel Tractors;
836 (7FR) Compactors;
988F (2ZR),
990 (4FR) Wheel Loaders;
5110 (7GN, 8HN) Excavators;
PM-565 (3TK) Cold Planers**

Reference: Special Instruction, "Disassembly And Assembly Of the 144-0835 Unit Injector Hydraulic Pump Group", REHS0192-03.

The engines in these machines are equipped with Hydraulically Actuated Electronic Unit Injectors (HEUI). A part of the HEUI system is the unit injector hydraulic pump group. The new 154-6732 Pump Kit is available to recondition the 134-9405 and 144-0835 Unit Injector Hydraulic Pump Groups rather than replacing the complete pump. The 154-6732 Pump Kit includes:

- Rotating Group.
- Control Piston.
- Yoke.
- Drive Shaft.
- Seal Kit.
- Front Bearing.
- Housing Gasket.
- Special Instruction, "Disassembly And Assembly Of the 144-0835 Unit Injector Hydraulic Pump Group", REHS0192-03.

Note: The Special Instruction identifies seven tools that must be fabricated to facilitate the disassembly and assembly of the pump. Contact the Caterpillar Dealer for the dimensions and specifications for fabricating the tools. Fabricating these tools will take some time, so please consider this before the first reconditioning of a pump.

Some additional information and corrections for Special Instruction, "Disassembly And Assembly Of the 144-0835 Unit Injector Hydraulic Pump Group", REHS0192-03 follow:

- On Page 2, under Required Tools, add the following sentence:

Contact the Caterpillar Dealer for the dimensions and specifications that are needed to fabricate the tools.

- On Page 4, remove Step 9.

- On Page 5, add the following information to the end of Step 14:

Visually inspect the 154-6735 Pintle Bearing (20). Replace the bearing with a new 154-6735 Pintle Bearing only if the bearing is defective.

- On Page 5, add the following information to the end of Step 15:

Visually inspect the 154-6735 Pintle Bearing. Replace the bearing with a new 154-6735 Pintle Bearing only if the bearing is defective.

- On Page 5, change Step 17 to read: Remove the spring seat (18) and spring.

- On Page 6, change the Note after Step 20 to read:

Note: Protect the face of the valve block by placing the face on a soft surface.

- On Page 6, add the following Note before Step 1:

Note: Thoroughly clean both the housing and the valve block before reassembling the unit injector pump.

- On Page 6, change Step 3 to read: Install the spring, the spring seat (18) and the yoke (22).

- On Page 8, change Step 9c to read: Once the rotating group is installed, turn the rotating group in order to ensure that the three pins (34) are still in the special notches. If the rotating group jams, the pins (34) need to be reinserted into the proper position. The three pins in the rotating group are held in the special notches with a "C" clip retaining ring. The "C" clip applies force against the inside diameter of the rotating group's cylinder block in order to hold the pins in position. See Illustration 32.

- On Page 9, after Step 18, add the following Note:

Note: Step 19 through Step 21 defines the procedure for the installation of the shaft seal. These steps should be followed precisely. The shaft seal should be placed barely below the face of the housing. The snap ring should then be positioned against the seal. Both the snap ring and the seal should be driven into the bore together until the snap ring seats in the groove.

- On Page 9, change Step 23b to read: Tighten the bolts (2) to a torque of $16 \pm 1 \text{ N}\cdot\text{m}$ ($12.0 \pm .5 \text{ lb ft}$).

Priming the 144-0835 Unit Injector Hydraulic Pump (07-20-98)

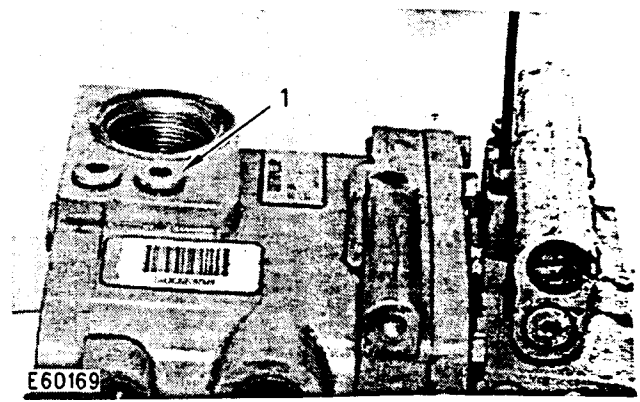
1714

D9R (7TL, 8BL),
D10R (3KR) Track-Type Tractors;
24H (7KK) Motor Graders;
73D (1GW) Underground Truck;
631E (1AB),
633E (2PS),
637E (1FB),
651E (4YR),
657E (5YR, 6PR, 6TR, 7KR) Wheel-Tractor
Scrapers;
769D (5TR),
771D (6JR),
773D (7ER),
775D (6KR) Off-Highway Trucks;
834B (7BR) Wheel Tractors;
836 (7FR) Compactors;
988F (2ZR),
990 (4FR) Wheel Loaders;
PM-565 (3TK) Cold Planers

References: Special Instruction, REHS0192-03, "Disassembly And Assembly Of The 144-0835 Unit Injector Hydraulic Pump Group".

Video, LEVN4245, "Disassembly And Assembly Of The Unit Injector Hydraulic Pump Group For 3408E And 3412E".

These machines are powered by 3408E (99C) or 3412E (80M) Engines which are equipped with Hydraulically Actuated Electronically Controlled Unit Injector fuel systems. After the unit injector hydraulic pump on one of these engines has been disassembled and assembled for servicing, the pump should be primed before attempting to start the engine.



Location to prime 144-0835 Unit Injector Hydraulic Pump.

To prime the 144-0835 Unit Injector Hydraulic Pump Group add one quart of engine oil to the reservoir of the pump through inlet (1). This adds the necessary amount of oil to the unit injector hydraulic pump so that the hydraulic pump will not be damaged and the engine will start without excessive cranking or wear.

1150 Front & Rear Covers

Flywheel Housing to Cylinder Block Joint Improvements (12-30-96)

1157, 1201

Caterpillar Machines Powered by 3408 and 3412 Engines

Reference Article: Service Magazine; November 25, 1996; Page 13; "Procedure For Installing Steel Core Gasket At The Front Housing And The Flywheel Housing"

Description Of Change: The flywheel housing to cylinder block joint uses a gasket to improve the integrity of the joint. The new gaskets are a steel core composite design with beading between the upper bolt holes to increase gasket loading in the tongue area of the housing.

One flywheel housing has changed from aluminum to cast iron.

Adaptable To: The new 109-4318 Gasket replaces the former 7N-9331 Gasket and the new 113-1474 Gasket replaces the former 8N-1911 Gasket in the flywheel housing groups in these engines. The former gaskets are canceled. Some engines that were built with 1U-8846 Liquid Gasket, between the cylinder block and flywheel housing, can be serviced with the new gaskets. See the chart for effectivity of the new gaskets.

Note: Due to heavy load factors, do NOT use the new gaskets in the 990 and 988F Wheel Loaders. Continue to use the 1U-8846 Liquid Gasket.

The new 113-1992 Flywheel Housing (cast iron) replaces the former 4P-8534 Flywheel Housing (aluminum).

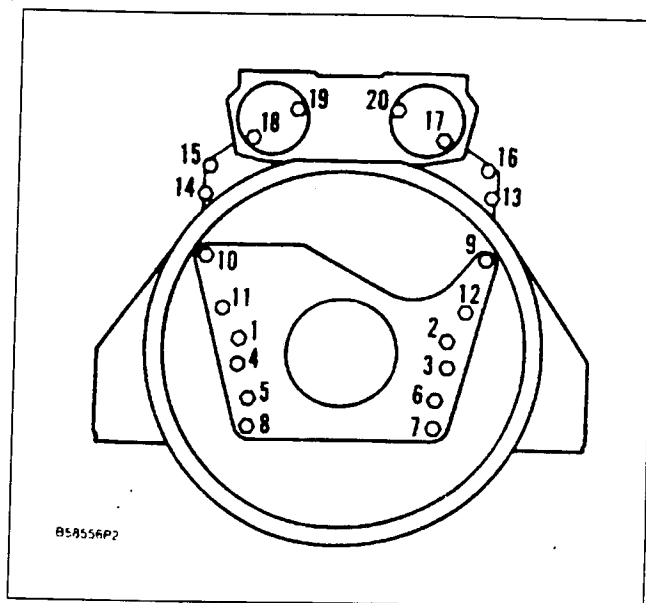
Effectivity Of New Flywheel Housing Gaskets And Flywheel Housing							
Engine	Machine	Former Flywheel Housing Gasket Part No.	New Flywheel Housing Gasket Part No.	Effective With Engine Serial No.	Former Flywheel Housing Part No.	New Flywheel Housing Part No.	Effective With Engine Serial No.
3408	PM450	7N-9331	109-4318	48W39069	4P-8534	113-1992	48W39069
3408	631E	7N-9331	109-4318	48W38261	4P-8534	113-1992	48W39064
3408	657E	7N-9331	109-4318	48W38261	4P-8534	113-1992	48W39064
3408	631F	7N-9331	109-4318	48W38261	4P-8534	113-1992	48W39064
3408	631D	7N-9331	109-4318	48W38261	4P-8534	113-1992	48W39064
3408	769C	8N-1911	113-1474	48W38412	7C-6948	-	-
3408	589	8N-1911	113-1474	48W38412	1W-1609	-	-
3408	834	8N-1911	113-1474	48W38412	1W-1609	-	-
3408	D9N	8N-1911	113-1474	48W38417	105-6140	-	-
3408	PM565	8N-1911	113-1474	48W38412	6I-4664	-	-
3412	992D	8N-1911	113-1474	73W16206	7C-6948	-	-
3412	773B	8N-1911	113-1474	73W16207	7C-6948	-	-
3412	D10N	8N-1911	113-1474	73W16208	105-6140	-	-

Installation of New Steel Core Flywheel Housing Gaskets

Before installing the gasket, existing sealant must be removed from the mating surfaces of the flywheel housing and cylinder block with 4C-4188 Paint Remover. Do not use a steel brush or rotary "Scotch Brite" pad to clean the surfaces. These may damage the contact surfaces. The previous gasket extended below the pan mounting surface and filled the entire block to flywheel housing joint. The 109-4318 and 113-1474 Flywheel Housing Gaskets with the steel core cannot be trimmed after assembly and is flush to recessed at the "Tee" joint between the block, flywheel housing, and oil pan. Seal the area not occupied with gasket material with 8T-9022 RTV Sealant (BLUE). This sealant is compatible with the gasket material. (For more complete instructions, see the Reference Article.)

Using the new 109-4318 or 113-1474 Flywheel Housing Gaskets on a flywheel housing originally designed for use with sealant may require elongation of the bolt holes in the pan, oil pan gasket, and stiffener plate (if equipped). The gasket is approximately 0.76 mm (.030 in) thick. Before engine operation, check the clearance between the flywheel housing and rear gear train and flywheel. Push the crankshaft towards the front of the engine when checking the flywheel to flywheel housing clearance. Flywheel housings designed for gaskets have a 16.76 mm (.660 in) dimension from the flywheel housing to the centerline of the oil pan mounting bolts. Flywheel housings designed for sealant have a 17.46 mm (.688 in) dimension from the flywheel housing mounting face to the centerline of the oil pan mounting bolts. These housings are usually marked with the note "CAUTION: USE ONLY LIQUID GASKET ON BLOCK JOINT" on the inside of the housing.

Bolt Tightening Procedure for "20 Bolt" Flywheel Housings



Bolt identification for "20 Bolt" flywheel housings.

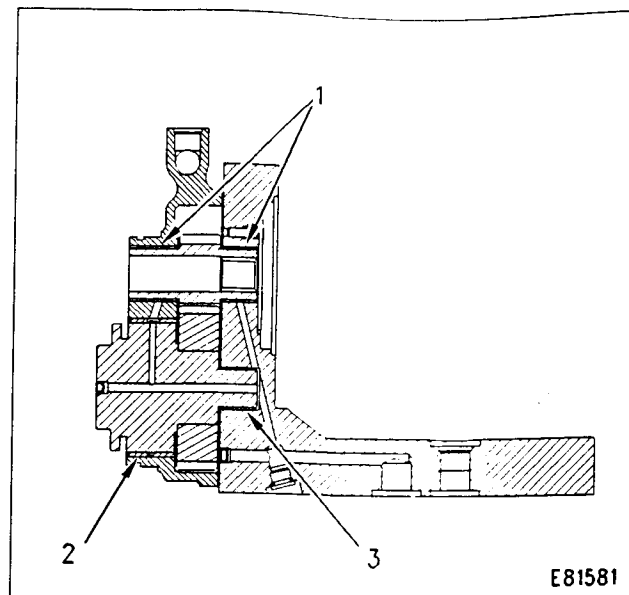
1. Tighten bolts 1 through 20 in numerical sequence to a torque of $40 \pm 10 \text{ N}\cdot\text{m}$ ($30 \pm 7 \text{ lb ft}$).
2. Tighten bolts 1 through 8 in numerical sequence to a torque of $135 \pm 20 \text{ N}\cdot\text{m}$ ($100 \pm 15 \text{ lb ft}$).
3. Tighten bolts 9 through 20 in numerical sequence to a torque of $55 \pm 10 \text{ N}\cdot\text{m}$ ($40 \pm 7 \text{ lb ft}$).

Bearing Specifications for 3408E and 3412E Hydraulically Actuated Electronically Controlled Unit Injector (HEUI) Hydraulic Drive Group (02-01-99)

1714

836 (7FR) Compactors;
 5110 (8HN, 7GN) Excavators;
 24H (7KK) Motor Graders;
 769D (5TR, 5SS),
 771D (6JR, 6YS),
 773D (7ER, 7CS),
 775D (6KR, 8AS) Off-Highway Trucks;
 AD40 (1YZ),
 AE40 (1ZZ) Articulated Trucks;
 PM-565 (3TK113-Up),
 PM-565B (8GS) Cold Planers;
 D9R (8BL830-Up, 7TL557-Up),
 D10R (3KR) Track-Type Tractors;
 988F (2ZR),
 990 (4FR) Wheel Loaders;
 834B (7BR),
 844 (2KZ) Wheel Tractors;
 631E Series II (1AB1640-Up, 1NB1390-Up),
 633E Series II (2PS),
 637E Series II (1FB532),
 651E (4YR),
 657E (5YR, 6PR, 6TR, 7KR) Scrapers

Description Of Change: The above machines are powered by 3408E and 3412E Engines equipped with HEUI Fuel Systems. The drive group for the unit injector hydraulic pump contains a shaft assembly and a gear that are supported by bearings within a housing assembly. Many of the parts contained in the pump drive groups have been changed in order to provide an improved service life.



Adaptable To: The drive groups that are currently in production are the 162-0148 for the 3408E Engine and the 162-0149 for the 3412E Engine.

The 162-0159 Housing is part of the 162-0158 Housing Assembly that is contained within both the 162-0148 and the 162-0149 Drive Groups. The new dimensions for the opening that supports the front shaft assembly should be 94.666 ± 0.013 mm ($3.7270 \pm .0005$ in). The new dimension for the opening that supports the front of the gear should be 37.994 ± 0.013 mm ($1.4958 \pm .0005$ in).

The 162-0157 Housing is part of the 162-0161 Housing Assembly that is contained within the 162-0148 Drive Group. The new dimensions for the opening in the 162-0157 Housing that supports the rear of the shaft assembly should be 28.636 ± 0.013 mm ($1.1274 \pm .0005$ in). The new dimensions for the opening that supports the rear of the gear should be 37.994 ± 0.013 mm ($1.4958 \pm .0005$ in).

The 162-0156 Housing is part of the 162-0160 Housing Assembly that is contained within the 162-0149 Drive Group. The new dimensions for the opening that supports the rear of the shaft assembly should be 28.636 ± 0.013 mm ($1.1274 \pm .0005$ in). The new dimensions for the opening that supports the rear of the gear should be 37.994 ± 0.013 mm ($1.4958 \pm .0005$ in).

The shaft assembly is supported by the larger 162-0152 Front Bearing and the smaller 162-0150 Rear Bearing. The 162-0155 Gear is supported by two 162-0151 Bearings, with one at either end. The new specifications for each of the new bearings are listed below.

162-0151 Bearing (1)

The outer diameter of the shaft is 34.900 ± 0.013 mm ($1.3740 \pm .0005$ in). The inner diameter of the assembled bearing is 35.003 ± 0.052 mm ($1.3780 \pm .0020$ in). The clearance between the bearing and the shaft assembly should be 0.038 to 0.168 mm (.0015 to .0066 in).

162-0152 Bearing (2)

The outer diameter of the shaft is 88.500 ± 0.013 mm ($3.4842 \pm .0005$ in). The inner diameter of the assembled bearing is 88.675 ± 0.073 mm ($3.4911 \pm .0029$ in). The clearance between the bearing and the shaft assembly should be 0.089 mm to 0.261 mm (.0035 in) to (.0103 in).

162-0150 Bearing (3)

The outer diameter of the shaft is 25.400 ± 0.013 mm ($1.0000 \pm .0005$ in). The inner diameter of the assembled bearing is 25.490 ± 0.052 mm ($1.0035 \pm .0020$ in). The clearance between the bearing and the shaft assembly should be 0.025 to 0.155 mm (.0010 to .0061 in).

If the specifications of any of these components are not within the given range, then the components should be replaced.

Current Part Number	Description	Former Part Number
162-0148	Drive Group (8 cylinder)	125-3427
162-0149	Drive Group (12 cylinder)	125-3430
162-0158	Housing Assembly	125-2730
162-0161	Housing Assembly (8 cylinder)	125-3426
162-0160	Housing Assembly (12 cylinder)	125-3429
162-0153	Shaft Assembly	125-3688
162-0155	Gear	124-6641
162-0152	Bearing	124-9336
162-0150	Bearing	9M-7129
162-0151	Bearing	124-9337

144-0835 Pump Enhancements (05-03-99)

1714

**836 (7FR386-Up) Compactors;
5110 (8HN1-Up, 7GN1-Up) Excavators;
24H (7KK67-Up) Motor Graders;
69D (9SS1-Up, 9XS1-Up),
73D (1GW1-Up),
769D (5TR1026-Up, 5SS75-Up),
771D (6JR302-Up, 6YS72-Up),
773D (7ER948-Up, 7CS76-Up),
775D (6KR374-Up, 8AS81-Up) Off-Highway**

Trucks;

**PM-565 (3TK113-Up),
PM-565B (8GS151-Up) Cold Planers;
D9R (8BL1368-Up, 7TL1080, 7TL1083-Up),
D10R (3KR1212-Up) Track-Type Tractors;
988F (2ZR1572-Up),
990 (4FR372-Up) Wheel Loaders;
834B (7BR662-Up),
844 (2KZ1-Up) Wheel Tractors;
631E Series II (1AB1842-Up, 1NB1433-Up),
633E Series II (2PS314-Up),
637E Series II (1FB776-Up),
651E (4YR221-Up),
657E (5YR283-Up, 6PR103-Up, 6TR215-Up,
7KR232-Up) Scrapers**

The 144-0835 Unit Injector Hydraulic Pump that provides the actuation energy for the fuel system on the 3408E and 3412E Engines has had several incremental improvements to its robustness. These changes have significantly increased the durability of the pump.

A through hardened control piston replaces the case hardened design. Once the case was broken on the former design, the piston would wear rapidly and pump control would be lost. The new piston is hardened completely through the entire piston.

The pump now has a full-support spherical washer which prevents debris from entering into the interface between the washer and the pump's shoe plate. Debris in this interface often lead to early wear out of the washer and the shoe plate.

The pump compensator group has changed in order to eliminate the adjusting screw that was retained with a patch lock insert. The new design is now a single solid screw that provides a positive adjustment. Engine starting failures were sometimes experienced with the previous screw when it allowed the compensator pressure setting to shift below the value needed for the engine start sequence.

The 166-5985 Compensator Kit and the 154-6732 Pump Kit are available. Disassembly and assembly instructions are detailed in Special Instruction, REHS0192. The pump may be bench tested following Test Procedure, NEHT6160.

1250 Fuel System

Seal Kits for Hydraulic Unit Injector Pump Groups Available (10-28-96)

1250, 1714

D9R (7TL, 8BL),
D10R (3KR) Track-Type Tractors;
24H (7KK) Motor Graders;
631E (1AB, 1NB),
633E (2PS),
637E (1FB),
651E (4YR),
657E (5YR),
834B (7BR) Wheel Tractors;
657E (6PR, 7KR) Wheel Scrapers;
769D (5TR),
771D (6JR),
773D (7ER),
775D (6KR) Off-Highway Trucks;
836 (7FR) Compactors;
988F (2ZR),
990 (4FR) Wheel Loaders;
5110 (7GN) Excavators

Description Of Change: Two new seal kits are available for hydraulic unit injector pump groups. The new seal kit is compatible with the 11 bolt flange on the former hydraulic unit injector pump group. The second new seal kit is compatible with a pump bearing design change.

Adaptable To: The former 125-3225 Hydraulic Unit Injector Pump Group (with the 9 bolt flange), released for the above machines powered by 3408E/3412E (99C1, 80M1) HEUI Engines is discontinued. The 126-7235 Seal Kit for the 9 bolt flange pump is available for service. The new 133-1706 Seal Kit is available for the 133-1708 Hydraulic Unit Injector Pump Group (with the 11 bolt flange). The 133-1708 Hydraulic Unit Injector Pump Group has been discontinued. The new 133-1706 Seal Kit is effective with the above machines powered by 3408E (99C169) and 3412E (80M154) HEUI Engines.

The new 138-6256 Seal Kit is available for the 134-9404 Hydraulic Unit Injector Pump Group. The 134-9404 Hydraulic Unit Injector Pump Group (with the new bearing design) is available for pump service. The new 138-6256 Seal Kit is effective with the above machines powered by 3408E (99C1101) and 3412E (80M596) HEUI Engines.

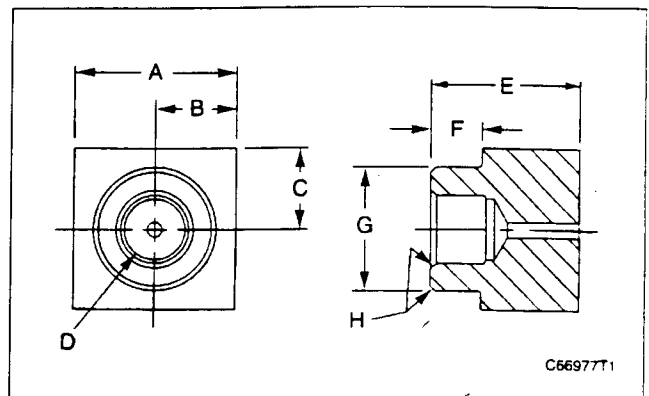
Use Fabricated Tools to Disassemble and Assemble 144-0835 High Pressure Oil Supply Pump on HEUI Engines (11-23-98)

1304-017

3408E (99C) and 3412E (80M) Machine Engines in Caterpillar Machines

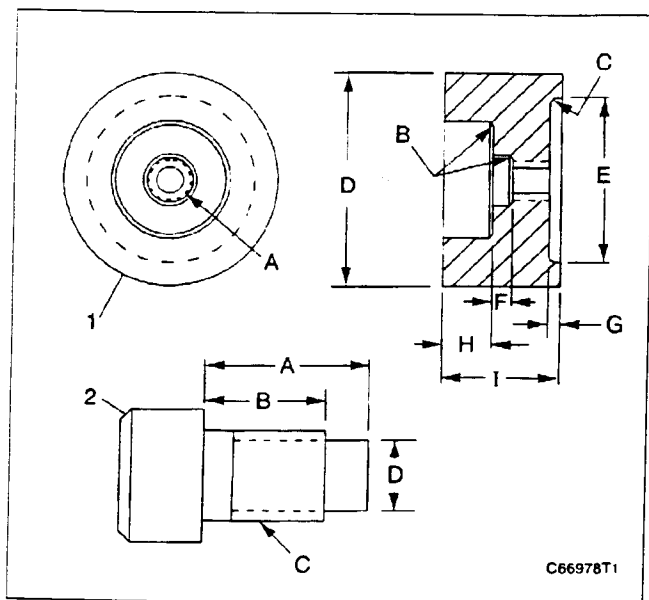
Features/Benefits

- Essential Tool
- Used to overhaul 144-0835 High Pressure Oil Pumps
- Tools include:
 - FT2606 Fixture, Yoke
 - FT2607 Tool, Bearing Press, (2 Required)
 - FT2608 Tool, Rear Bearing Installation
 - FT2609 Tool, Valve Block Positioning
 - FT2610 Remover, Front Bearing
 - FT2611 Support, Front Bearing (HEUI)
 - FT2612 Remover, Rear Bearing



FT2606 Yoke Fixture made from SAE1018 Steel

- (A) 66 mm (2.60 in) square
(B) 33.00 ± 0.13 mm ($1.30 \pm .005$ in)
(C) 33 mm (1.30 in)
(D) Drill $5.00 + 0.25 / - 0.10$ mm ($.190 + .010 / - .004$ in) diameter hole through;
Pilot drill hole to 25 mm (1.0 in) minimum depth; machine 27.25 ± 0.01 mm ($1.070 \pm .001$ in) diameter to 20.7 mm (.81 in) minimum depth
(E) 61.5 mm (2.42 in) minimum
(F) 20.5 mm (.81 in) minimum
(G) $50.50 \pm .10$ mm ($1.999 \pm .004$ in) diameter
(H) 2.0 ± 1.0 mm ($.08 \pm .04$ in) x 45 degrees



FT2607 Bearing Press Tool

Item 1 made from steel

(A) $8.20 \pm 0.15 / - 0.08$ mm (.320 + .006 / - .003 in) diameter;
3/8-16-2B thread;

11.0 ± 0.5 mm (.43 $\pm .02$ in) counterbore diameter;

28.00 + 0.25 / - 0.13 mm (1.100 + .010 / - .005 in) to depth shown

(B) 1.50 mm (.06 in) maximum radius

(C) 0.25 mm (.010 in) maximum radius

(D) 50.40 ± 0.13 mm (1.98 $\pm .005$ in) diameter

(E) 40.00 ± 0.13 mm (1.58 $\pm .005$ in) diameter

(F) 4.50 mm (.18 in)

(G) 1.98 ± 0.01 mm (.08 $\pm .001$ in)

(H) 11.50 ± 1.0 mm (.45 $\pm .04$ in)

(I) 27.00 ± 0.13 mm (1.06 $\pm .005$ in)

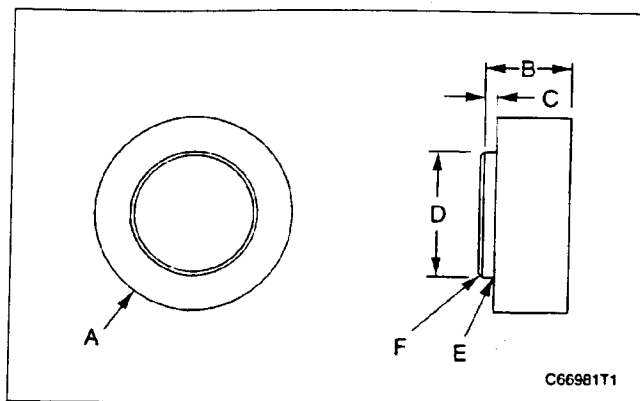
Item 2 made from 1L-0509 Screw

(A) 19.05 mm (.75 in)

(B) 14 ± 1 mm (.55 $\pm .04$ in)

(C) 3/8-16 thread

(D) 7.0 ± 0.5 mm (.28 $\pm .02$ in) diameter



FT2609 Valve Block Positioning Tool made from steel

(A) 70 mm (2.8 in) minimum diameter

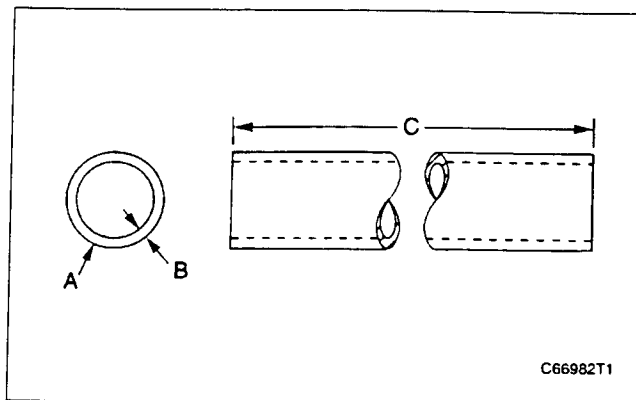
(B) 31.8 mm (1.25 in) minimum

(C) 6.35 ± 1.00 mm (.25 $\pm .04$ in)

(D) 44.45 ± 0.13 mm (1.750 $\pm .005$ in) diameter

(E) 1.00 mm (.040 in) maximum radius

(F) 1.0 ± 0.5 mm (.04 $\pm .02$ in) x 45 degrees



FT2610 Front Bearing Remover made from -24 steel
hydraulic tubing

(A) 38.1 mm (1.50 in) stock tolerance diameter

(B) 3.4 mm (.13 in) stock tolerance

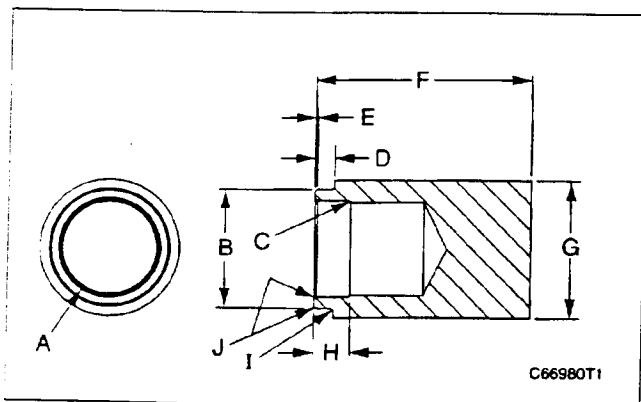
(C) 230 mm (9.1 in) minimum

FT2611 Front Bearing Support made from -20 steel
hydraulic tubing

(A) 31.8 mm (1.25 in) stock tolerance diameter

(B) 1.6 mm (.06 in) stock tolerance

(C) 63.5 mm (2.50 in) minimum



FT2608 Rear Bearing Installation Tool made from steel

(A) $31.80 \pm 0.25 / - 0.13$ mm (1.250 + .010 / - .005 in) diameter
to 38.1 mm (1.50 in) depth;

$32.50 \pm 0.25 / - 0.13$ mm (1.28 + .010 / - .005 in) diameter to
depth shown

(B) 41.27 ± 0.13 mm (1.625 $\pm .005$ in) diameter

(C) 0.25 mm (.010 in) maximum radius

(D) 7.08 ± 0.05 mm (.279 $\pm .002$ in)

(E) 1.0 ± 0.5 mm (.04 $\pm .02$ in)

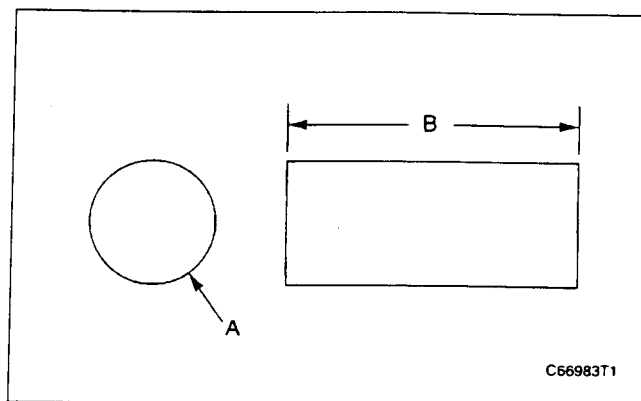
(F) 75 mm (3.0 in) minimum

(G) 48.26 mm (1.90 in) diameter

(H) 12.7 ± 1.0 mm (.50 $\pm .04$ in)

(I) 1.0 ± 0.5 mm (.04 $\pm .02$ in) radius

(J) 30 ± 1 degree



FT2612 Rear Bearing Remover made from SAE1018 Steel

(A) 31.8 mm (1.25 in) stock tolerance diameter

(B) 75 mm (3.0 in) minimum

Reference

REHS0192; Special Instruction; Disassembly and Assembly of 144-0835 Unit Injector Hydraulic Pump Group.

New High Pressure Oil Hose Assembly Now Used (01-25-99)

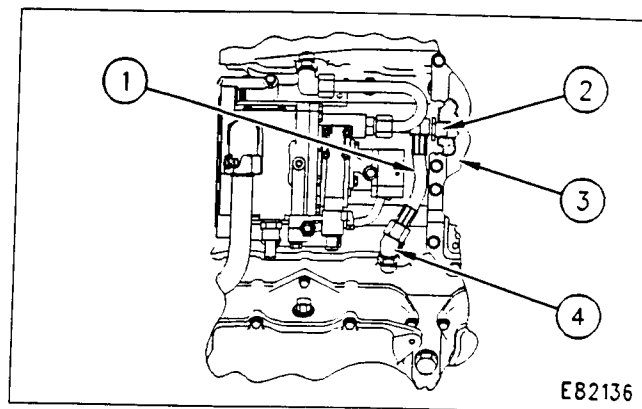
1307

836 (7FR386-Up) Compactors;
5110 (8HN, 7GN) Excavators;
24H (7KK67-Up) Motor Graders;
769D (5TR1026-Up, 5SS75-Up),
771D (6JR302-Up, 6YS72-Up),
773D (7ER948-Up, 7CS76-Up),
775D (6KR374-Up, 8AS81-Up) Off-Highway Trucks;
AD40 (1YZ),
AE40 (1ZZ) Articulated Trucks;
PM-565 (3TK113-Up),
PM-565B (8GS151-Up) Cold Planers;
D9R (8BL1368-Up, 7TL1080, 1083-Up),
D10R (3KR1212-Up) Track-Type Tractors;
988F (2ZR1572-Up),
990 (4FR372-Up) Wheel Loaders;
834B (7BR662-Up),
844 (2KZ) Wheel Tractors;
631E Series II (1AB1842-Up, 1NB1433-Up),
633E Series II (2PS314-Up),
637E Series II (1FB776-Up),
651E (4YR221-Up),
657E (5YR283-Up, 6PR103-Up, 6TR215-Up, 7KR232-Up) Scrapers

Description Of Change: A new more robust braided stainless steel hose assembly is now being used in the lines group for the unit injector hydraulic pump used in the 3408E and 3412E Engines that power the above machines. This new hose assembly allows for added flexibility and thermal expansion, which will extend its life and improve reliability.

Adaptable To: The new 162-2501 Hose Assembly replaces the former 107-7942 Hose Assembly, and is used in the 121-4034 Lines Group-Injector Hydraulic Pump for 3408E Engines and 109-0399 Lines Group-Injector Hydraulic Pump for 3412E Engines. The new hose assembly connects the hydraulically actuated electronically controlled unit injector (HEUI) pump to the left pressure manifold. The new hose assembly is in effect as shown above.

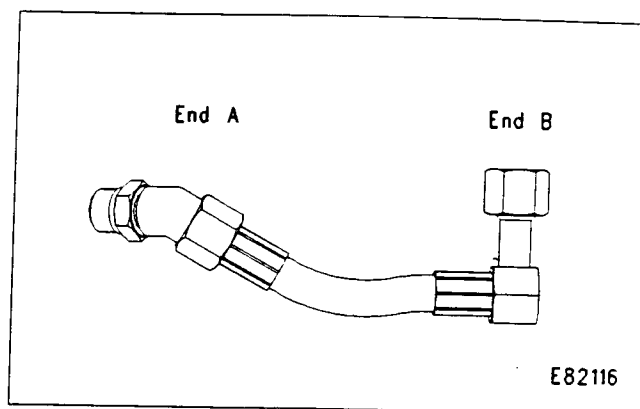
Installation Procedure



1. Remove the old hose assembly 107-7942 with all fittings attached.
2. Remove elbow (4) that feeds the left high pressure manifold from the old hose assembly. This piece will be reused in the installation of the new hose assembly.

Note: Step 2.5 is for 3408E Engines only.

2.5. Remove 7W-6492 Plug from the aftercooler housing. Install new 8T-6762 Square Socket Plug (2) in aftercooler housing (3).



3. Install elbow (4) to the left high pressure manifold and hand tighten.
4. Hand tighten the nut on end A of 162-2501 Hose Assembly (1) to elbow (4).
5. Install hose end B to the pump fitting and tighten the nut to a torque of $125 \pm 15 \text{ N}\cdot\text{m}$ ($92 \pm 11 \text{ lb ft}$).
6. Hold end A elbow and tighten the jam nut to a torque of $143 \pm 15 \text{ N}\cdot\text{m}$ ($105 \pm 11 \text{ lb ft}$).
7. Tighten hose end A nut to a torque of $125 \pm 15 \text{ N}\cdot\text{m}$ ($92 \pm 11 \text{ lb ft}$).